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A PAYING GUEST

By Dr. Edwin E. Slosson

A new and startling theory of how we got our good red blood is advanced by Mr. Needham of Cambridge. He suggests that the red corpuscles, now a necessary factor in animal life, first entered as foreign invaders in search of food. Sometime back in the Pre-Cambrian, he surmises, when the ancestors of all mammals were still swimming in the sea and had not yet closed their circulatory system, they were penetrated by certain single and free-swimming cells, which, finding here abundance of nitrogenous nutriment, made themselves at home and in time became indispensible to their host. They swallowed the red coloring matter, a waste product which had been hard to get ridof, and used this as a medium for carrying fresh oxygen from the lungs to the muscles , so when the creature took to living on land it was able to make full use of the free air it found there.

Many such cases of partnership for mutual benefit are known to biologists who call the arrangement "symbiosis". Certain sea-worms operate a system closely corresponding to this hypothetical scheme. Being devoid of chlorophyll, the green coloring matter of plants , they have no way of manufacturing sugary foods for themselves. But after they are infected with the small green cells of certain algae the needs of both are satisfied. The green guests prepare carbohydrates by aid of the sunshine and in turn live on the protein products of their hosts.

But if the green plant cells fail to keep up the food supply the animal gets hungry and digests the vegetable invaders, although this means suicide. Something of this sort happens in the animal body, when the red blood corpuscles dissolve and disappear faster than they can be replaced, "pernicious anemia" the doctors call it. But the person, who shows such ingratitude to the uninvited guests that have become such useful servants, is sure to suffer for it.

SCIENCE EXPLAINS ATHLETIC RECORDS

By Watson Davis

In what kind of sport a student is most likely to excel may be determined by a phsyiological examination, according to Prof. A. V. Hill of London University. In his presidential address before the physiological section of the British Association for the Advancement of Science at Southampton, he showed curves, based on many years of experimentation, from which it is possible to tell how many yards a man can run without exhaustion, and what is his best speed. He finds that this depends chiefly upon the ability to supply sufficient oxygen from the air and to dispose of the products of combustion accumulating in the muscle from exertion. The oxygen used by the body is the measure of the energy expended. One liter of oxygen, about a quart, would be sufficient , if it could be used with a hundred per cent efficiency, to raise a weight of one ton to a height of seven feet.

In running, the oxygen needed increases as the square or cube of the spped. That is, running twice as fast requires from four to sixteen times as much oxygen per minute. A man taking 240 steps per minute may consume eight liters of oxygen a minute while if he speeds up to 280 steps he may require twenty-four liters. But a runner may for a short time consume more osygen than he can breatherin, just as a man may for a while spend more than his income. An athlete, for instance, may have a maximum intake of four liters a minute and be capable of running into debt for oxygen to the extent of fifteen liters. If then he was running at a speed requiring five liters of oxygen a minute, he would have to draw on his reserves at the rate of a liter a minute and at the end of fifteen minutes would be exhausted.

The possibility of thus overdrawing one's oxygen income depends upon a mechanism of the muscle by which lactic acid, the sour milk acid, may be accumulated to be oxidized off when the exercise is over. The muscles therefore serve as storage batteries for energy to be drawn upon in an emergency and recharged when the man has leisure to catch his breath again. The inability of women to match the highest athletic records of the men is due to their lesser energy reserve. Women may have as much skill as men but on the average they can expend in a given time 67 per cent of the energy available to men. Dr. Hill suggests:

> "An enterprising woman athlete who wants to break a record should avoid the 300 meters; she would be well advised to try the 500 meters."

The scientific study of the feats of trained athletes discloses facts that would have appeared incredible. For instance, Dr. Hill says of the mechanics of high jumping.

> "Paradoxical as it may seem , it is possible for an object to pass over a bar while its centre of gravity passes beneath; every particle in the object may go over the bar and yet the whole time its centre of gravity may be below. A rope running over a pulley and falling on the other side is an obvious example . It is concei vable that by suitable contortions the more accomplished high-jumpers may clear the bar without getting their centres of gravity above or appreciably above it. Let us calculate, however, on the assumption that the centre of gravity of a jumper just clears the bar. The world's record high-jump is 6.61 feet, the centre of gravity of the performer being presumably about 3 feet high at rest. He raises it therefore 3.61 feet into the air , from which we may calculate that the whole time occupied in the jump is about 0.96 second. Seeing the amazing complexity of and the skill involved in the rapid movements and adjustments involved in a record high-jump, it is striking that all those events can occur within a time of less than one second."

WOULD USE RADIO TO LEARN IF CONTINENTS ARE DRIFTING

Are American and Europe drifting farther apart? This question, asked in a geological and not in a polititcal sense, was set before the meeting of the British Association by Prof. J. W. Gregory, who proposed to answer it by the use of wireless time signals for the determination of variations in longitude. Kept up for a few years, he said, these would afford a conclusive test of the theory recently advanced by Wegener, that the Atlantic Ocean was produced by the drifting apart of the Americas on one side and Europe and Africa on the other.

The reality of a drifting motion of whole continents is now seriously accepted by many geologists. Recent investigations have shown that beneath the uppermost sixty miles or so of rocky crust, there is a semi-molten layer of magma or lava overlying the earth's solid central core, and on this viscid mass the continental blocks find more or less uncertain footing. The idea of a drift also receives support from the rather suggestive reciprocity of the projections and indentations of the Atlantic shores of America and the Eurafrican coastline.

Prof. Gregory was not inclined, however, to admit the rapidity of drift postulated by the Wegener theory, and it is to get a critical test of this disputed question that he proposed the use of radio time signals.

SAYS GALILEE SKULL MARKS DISTINCT NEANDERTHAL RACE

Man in Neanderthal times was divided into distinct races just as he is today, according to the evidence of the newly discovered Stone Age skull found near Capernaum in Galilee. Discussing the find before the meeting Sir Arthur Keith characterized the man to whom the skull had once belonged as a twenty-five-year-old representative of a new race of the Neanderthal type, differing from the European Neanderthal skulls previously known in being relatively high and narrow. This Neanderthaler of ancient Palestine had a brain showing the development of the higher faculties, including probably even speech; it has long been considered doubtful whether men of the Neanderthal ages were really capable of articulate speech, though they were undoubtedly human beings.

Implements and animal remains found with the skull show that it corresponds to the Mousterian era of the Old Stone Age in Europe, estimated at from 25,000 to 50,000 years ago. Three healed wounds indicate trephining, or possibly some mysterious disease.

Floods are of common occurrence at Leningrad; in fact they are as familiar to the inhabitants as eruptions of Vesuvius are to the population of Naples.

The lengendary lotus, the fruit of which made Ulysses's sailors forget their homes, is supposed to have been the same plantnow used by natives of northern Africa to make sun-dried cakes which taste like gingerbread.

SEX SHOWN BY CHEMICAL TEST

A chemical test for sex, so delicate that with a few drops of blood or of extract of plant juices, it will show whether the animal or plant was male or female, is being used at the Department of Genetics of the Carnegie Institution of Washington. The two scientists who are using it, Miss Sophia Satina and M. Demerc, state that it was originally worked out in Russia by Drs, E, O. Manoilov and O. Gruenberg, but that it has only recently become known outside of that country.

When applied to dilute solutions of animal blood, a few drops of the reagents cause the blood of male animals to lose its color, while under the same treatment the blood of female animals remains reddish-violet.

The original discoverer, Dr. Manoilov, believed that the reaction depended on differences between the hemoglobin, or red coloring matter, in the blood of male and female animals. In order to see whether this theory also applied to the green coloring matter in plants, which is chemically similar to hemoglobin, the experimeters have tried it on plant solutions. They found that the green coloring-matter apparently has nothing to do with the reaction, though the plant extracts responded to the tests as defintely as did animal blood.

Whatever the unknown basis of sex may be, it is apparently the same thoughout the whole range of the plant and animal kingdoms, for the test has been applied with success to the determination of sex in such diverse forms of life as mice, sheep, pigeons, fruit-flies, sea-weed, willows, poplars, hemp, begonia, and a number of other plants.

PRIMITIVE RACES USE MODERN CHILD TRAINING

When juvenile courts and modern educators advise against punishment of children they are advocating no new thing. In ten years observation of the native Bantus of Central Africa, not one case of a child's being punished was observed by Prof. Ellsworth Faris of the University of Chicago, who has made an investigation of the extent and probable origin of punishment. And in North America, from the Eskimos on the north to the Pueblos on the south, punishment of children was unknown before the white man came, and adults were punished only infrequently and for very serious offenses. Punishment probably began with slaves and wives adopted out of stranger tribes, and it is only in civilized groups that the punishing -custom has spread to children.

Punishment, says Professor Faris, is a compromise between revenge and forgiveness and probably occurred first when outsiders were brought into an otherwise homogeneous group. The individual born into a primitive group is unified with the group almost as closly as the hand is with the body. This unity causes submission to the dictates of group customs and also prohibits punishment, since the group cannot punish itself, just as one does not punish his own hand for its mistakes. The opposite extreme to this forebearance is found inthe attitude of revenge which primitive groups take toward enemy tribes, whom they regard as scarcely human and seek to annihilate outright.

In primitive groups it is only outsiders who are punished. Children are trained by means of myths and folktales containing the moral and social code of t

tribe. These are told to the children in the family circle, by the elders of the tribe or by men especially appointed. Should disobedience occur, it is stopped by gentle ridicule, and sometimes by fasting and other religious ceremonies.

SALMON GUIDED IN UPSTREAM JOURNEY BY TEMPERATURE

Some of the secrets of how and why the salmon year after year finds its way to its spawning ground by navigating a maze of forking rivers have been discovered by Prof. Henry B. Ward of the University of Illinois.

No single factor is adequate to explain all the activities of an aquatic animal Prof. Ward has found, but some have greater influence than others. In an intensive study of the fresh water life of the Pacific salmon he discovered that temperature plays a large part in the salmon's life.

"The life history of the Pacific salmon may be divided readily into three chapters, first the early life of the young fish in fresh water, second, the period of growth in the ocean, and third the wandering of the adult through freshwater to the spawning grounds, in which the reproductive process is invariably terminated by death", he says.

"The red or sockeye salmon follows a definite course in its migration moving steadily upstream against the current. This positive response to the current stimulus is not adequate to explain its action at two points, first at stream junctions, and second in selecting a precise place to spawn. When the red salmon reaches a fork in the stream, it does not necessarily select the larger, the clearer, the deeper or the swifter branch but in an extensive series of observations I have found that it always selects the colder water. The determining influence appears to be the relative temperature of the two branches rather than the absolute temperature of either. If both branches should have the same temperature, some other factor would determine the choice and it may be that such a factor might in special cases overrule the temperature stimulus. But no such cases have been observed. In testing this stimulus, observations must be made at the exact time when the fish are moving up the stream.

"The red salmon regularly spawn in a lake, and in all cases observed it selected that part of the lake margin where an inflow of seepage water was demonstrated. At such points the water is distinctly colder than elsewhere along the shore. During the winter, however, these areas would be warmer and the water would be protected from freezing. In the exceptional cases when the red salmon does not spawn in a lake, it still deposits its eggs in spring-fed areas. This response to the temperature stimulus is of fundamental importance since it protects the eggs against the destruction which would be inevitable if they were actually frozen.

"The movements of aquatic animals are directed by influences which are partly internal and partly external or environmental. Even though the latter be complex, careful and continued observation will serve to show what influencesare most significant in directing and controlling the activities of a particular species. Confusion easily results from applying to one form conclusions reached in the study of other species."

THYROID GLAND GIVES CHICKENS NEW FEATHERS

"Off again, on again," says M. Zavadovski to himself as he harvests crop after crop of new chicken feathers from the hens in his laboratory at Sverdlov University, as a result of feeding them doses of dried thyroid gland. In experimenting to study the effect of excessive thyroid in hens with a view to applying the knowledge gained in treating human cases, M. Zavadovski observed that chickens moulted artificially two weeks after one strong dose of thyroid was given and grew new feathers in another two weeks. Th new feathers were always white, regardless of the color of the original plumage.

It was also shown that fowl could withstand large doses of thyroid without symptons of acute poisoning, and the fact of cumulative action of the thyroid hormone was confirmed, for they could endure large doses in one administration better than daily small ones. The quickness with which the fowl lost the old feathers and put on the new depended on the size of thedose. The biggest dose that could be given induced moulting in six days and brought new white feathers in seventeen. The method of giving single doses enabled the experimenter to obtain a picked chicken in two weeks and one with new plumage in four.

The new plumage that grew after experimental moulting was markedly softer than the original but was not so easily changed by a second dose of thyroid . When M. Zavadovski grafted a thyroid gland from a dog under the wing or on some other part of the fowl, white feathers grew at the site of the operation but moulting did not occur.

FINDS HYDROGEN TIDES ON REMOTE STAR

What is that distant sun, known to astronomers as Kappa Draconis, doing with its hydrogen? Dr. Otto Struve, of Yerkes Observatory, brought this question before the recent meeting of the American Astronomical Society. He has not found the answer yet himself; all he has discovered is that at times this inconspicuous member of the stellar universe seems to have plenty of the lightest of the elements, and after the lapse of a number of years that the hydrogen is gone again.

In 1890 Dr. E. C. Pickering, then the director of the Harvard College Observatory, discovered bright lines in the hydrogen region of this star's spectrum. Making a study of the photographic records filed at Yerkes Observatory, Dr. Struve has discovered that these lines grew fainter and fainter, until they disappeared completely in 1904. They reappeared in 1911, became brighter until 1919, and have remained steady since that time. Now Dr. Struve expects them to weaken and disappear once more. But he has no explanation to hazard for such erratic behavior on the part of a distant sun.

Negro criminals closely resemble white criminals in that those who commit crimes against property are mentally superior to those who commit crimes against persons.

Thirteen new national forests with a total area of 354,509 acres have been created during the past six months.

CLOUDS OF CALCIUM MAKE VAST CELESTIAL LIMELIGHTS

Clouds of calcium, the element responsible for lime, marble, chalk, and a number of other familiar things, but blown out to atomic fineness and fiery heat, wander in stellar space. In some places double stars, pairs of twin suns, rotate about each other in the midst of such an eddying celestial limelight. Dr. Otto Struve, of Yerkes Observatory, discussed them today before the meeting of the American Astronomical Society at Northfield, Minn.

His attention was first drawn to the existence of these calcium clouds, Dr. Struve said, because certain lines from double stars did not shift when photographed through the spectroscopic telescope, as they should have if the light emanated from the twin suns of a double star, as they alternately advance and retreat. Further observations led him to the conclusion that these lines were due to the element calcium, which formed a sort of envelope of glowing stellar mist about the whole of the double solar systems. Further search of the heavens discovered other calcium clouds without any stars in them; such masses lie mostly along the line of the milky way.

WORLD'S BIGGEST TELESCOPE REVEALS OTHER UNIVERSES

By James Stokley,
(Science Service Staff Writer)

Five hundred years ago men thought the earth the center of the universe, all the heavenly bodies, they believed , were subordinate to it. Then came Nicolaus Copernicus who showed that the earth was merely one of a system of planets revolving around the sun. A hundred years ago, the great English astronomer, Sir William Herschel, demonstrated that the sun, together with all the other stars that we see in the heavens, formed a vast system roughly the shape of a grindstone. And now, as a worthy successor to these great men, Dr. Edwin P. Hubble, of the Mt. Wilson Observatory, has shown that this universe of stars is but one of many such universes thousands of which dot the sky, and may be seen as far as our great modern telescopes can reach.

Recently Dr. Hubble told the members of the National Academy of Sciences of his work. Then he explained how, with the great 100 inch reflecting telescope, the largest in the world, he had made many photographs of two of the nearest of these universes, or spiral nebulae, as the astronomer calls them. Previously they had often been photographed with smaller telescopes, and always appeared as continuous areas of light, much the same as the Milky Way appears to the unaided eye. But just as the Milky Way is seen with even a small telescope to consist of hordes of stars, so did Dr. Hubble's photographs reveal the stars of which these spiral nebulae consist. He told how, applying a method successfully used on the nearer globular star clusters by his former colleague at Mt. Wilson, Dr. Harlow Shapley, now director of the Harvard College Observatory, he had found their distance.

This method was possible because the photographs showed a number of stars which undergo a periodic variation of light, and from the time that it takes the star to complete one of these cycles of varying brightness, the astronomer can calculate their actual brilliancy. Knowing how bright they actually are, and how bright they appear on the photographs, their distance may be measured, because light diminishes

as the square of the distance increases. In such a way, Dr. Hubble found the distance of these two spirals was each about a million light years - a million times six trillion miles; the distance that light, moving with a speed sufficient to encirled the earth seven times in a second, can travel in a million years.

But this did not satisfy some of the astronomers. "This method," they said in effect, "has only been tested on much shorter distances. We do not know whether or not they would act the same when so far away." It is to answer this objection that Dr. Hubble is now working, and as I sat in his office recently he showed me how, by two quite independent methods, he has arrived at similar distances. He finds that the stars in the spirals seem to behave the same as our system would if it were removed so far from us. There have been observed in the Andromeda nebula, one of the two that he has studied, 53 "novae", or new stars. These occasionally appear in our own system when a star, formerly very faint, flares up for a while, and then gradually returns to its former magnitude. If we assume that the average brightness of those in the spirals is similar to those in the Milky Way, their apparent faintness may be explained if they are at a much greater distance, and the distance is about a million light years.

Important and epoch making as this work is, it is merely a part of the work going on at the Mt. Wilson Observatory, which boasts a larger staff than any similar institution. The 100 inch telescope , for example, is used in a great variety of ways, as is the 60 inch telescope, the third largest in the world. One of the chief uses is in photographing the spectra of stars, from which, by Dr. Adams' method, their distance may be found; but these spectra also tell, to thoe who can read the message, many other facts as to the star's motion and composition. Photographs made with these two instruments are also used by Dr. Adrian Van Maanen in measuring stellar distances, or parallaxes, by their displacements due to the motion of the earth in its orbit, and revealed when photographs made six months apart are compared.

From the start, when the observatory was founded by Dr. George Ellery Hale, who was the director for many years, until poor health forced him to resign and assume the position of honorary director, which he nows holds, the sun has been one of the principal objects of study. Indeed, until a few years ago, it was officially called the Mt. Wilson Solar Observatory of the Carnegie Institution of Washington", but now the word "solar" in the title has been dropped. Erected solely for solar study are the two tower telescopes, one 75 feet and the other 150 feet high, which may be seen surmounting Mt. Wilson from the city of Pasadena and also from more distant points. Each of these consists of a steel tower, with a dome at the top. In each dome is an arrangement of mirrors which collect the sunlight and reflect it into a lens, forming an image of the solar disc at the base.

With them, direct photographs may be made, or else the sun may be photographed by the light of one of the elements that it contains, such as hydrogen of calcium. This is accomplished with the "spectroheliograph", an ingenious instrument of Dr. Hale's invention. But this is not sufficient, and under each tower is a well, 30 feet deep for the smaller tower, and 75 feet for the larger. At the bottom of each well is a diffraction grating, which, like a prism, breaks up the sunlight into a spectrum. This is reflected back to the base of the tower, where photographs are made showing the dark spectral lines which mean so much to the astronomer.

Every clear day, and with the southern California climate there are usually about 300 of them annually, the sun is photographed in every possible way. This work has continued for many years, and already has led to the discovery of a number of important facts concerning the source of the earth' s light and energy.

HOW MANY LIVES HAS A T.B. GERM?

By Dr. Philip P. Jacobs

There is an old saying that a cat has nine lives and that no self-respecting pussy is really dead until she has passed through these several stages of mortality. Be that as it may, there is a germ that seems to have even more than the proverbial nine lives. I refer to that member of the germ tribe known as the "tubercle bacillus", the little rod-like parasite that causes tuberculosis.

Before we discuss some of the many lives of this little animal or vegetable, (we do not know which it is), let us make very sure that we all agree that you cannot have tuberculosis without the germ. There are some folks who have anotion that consumption or tuberculosis is a sort of constitutional disease and that you can have it without the germ, but these folks are merely focling themselves.

The tuberculosis germ, unlike most of the other germs, has, in addition to his ordinary vitality, or rather extraordinary vitality, an armor coat of wax. Nearly half of the germ is wax and so thoroughly does the wax protect this little rod-like cylindrical creature that it is almost impossible to kill it. Direct sunlight seems to be the quickest way to dry him up; and I have often wondered whether it is not because the sunlight melted his armor?

In addition to having this waxy coat, however, the tuberculosis germ has anoth: way of protecting himself. When he gets into the body he has a way of getting the cell tissues to react by building a wall about him. In other words, he gets his host to cover him up and protect him. This covering, because it is round and hard, and shaped like a pea is called from the Latin word, "tubercle".

Many adult persons have tubercle, particularly those who live in cities or wher there are crowds of people constantly associating together. But the tubercle is perfectly harmless and need not cause anyone alarm. It is only when the original tubercle breaks down, because of lowered resistance, that trouble begins and disease or as we call it, tuberculosis takes hold of the victim.

There have been many attempts to kill the wily tuberculosis germ within the body, but as one can readily see, unless a liquid, a gas or a poison of some sort is used, that will penetrate the tubercle and the wax coat of the germ, one might as well not try. All sorts of chemicals have been used, from precious metals down to ordinary earth, and every conceivable gas that could be inhaled or taken without danger has been tried, but without success. There are things that one could take that would kill the tuberculosis germ within the body, but they would kill the man before they killed the germ. Recently a Danish savant, widely heralded through the newspapers, Moellgaard by name, announced that a solution of gold salts, known as "Sanocrysin", would do what others had tried to do for years. But Moellgaard's own reports indicated that most of the people on whom he tried "Sanocrysin" died before the germs were killed. Experiments in this country have not borne out the flattering cabled reports from abroad.

In an effort to find out more about the possibilities of killing the tuberculosis germ within the body and to increase our knowledge generally about what happens when the germ gets into the body, the National Tuberculosis Association, through its Medical Research Committee, is now engaged in a systematic, organized hunt. One after another of the various layers of the tuberculosis germ are being peeled off and this tiny little micro-organism is being broken up into its many chemical and other constituents. By and by we will know what it is in the tuberculosis germ that

that really causes tuberculosis. We do not know it now. By and by we will know what it is in the tuberculosis germ that makes tubercle. We do not know that now. Some day we are going to know how to take the hide off the germ without killing the person who has the germ. This is all the work of the medical researchers. The more we learn about the tuberculosis germ the more we can do to discover the cause of its many lives, and the sooner will we be able to get rid of this pest.

TABLOID BOOK REVIEW

FISHES, By David Starr Jordan. D. Appleton and Company, 1925 773 pages; 18 colored plates. $7.50

In his prefatory note, Doctor Jordan states simply, "In this volume the writer has tried to compress all that an educated man is likely to know, or to care to know about fishes". And since the one who is undertaking the compressing is admitted to be the tenant of the true apostolic succession in matters piscine, what need is there to say more? Except, perhaps, about the plates, which are veritably miraculous draughts of fishes. But these must be seen to be appreciated. And even then you'll scarcely believe some of them. Such chimaeras and living garagoyles there are that swim the tropical seas. If you are at all interested in fishes, and have a little money that you can't spare for books, this combination of the beautiful and the authoritative is the thing to spend it on.

GASOLINE: What Every One Should Know About It. By T. A. Boyd, head of the fuel section, General Motors Research Corporation. New York. F. A. Stokes Co. 1925 $2.50

This book aims to give the motorist a better understanding of the important fuel that runs 17,000,000 American automobiles. How the refiner has made more and more gasoline from a barrel of crude oil; what is good gasoline; how good roads affect miles per gallon; the part of the public in getting greater mileage out of a gallon of gasoline, and how American cars, like some human beings, are overfed; and the automobile fuel of the future, are some of the topics which the author discussed in readable style. The book is well illustrated.

PLEASANT JOBS PAY BEST, INVESTIGATOR FINDS

The able man or woman not only has the fun of being clever but also of being well paid because workers in their class are rare, while the uninteresting and unpleasant jobs are poorly paid because there are so many that can do them. This is the conclusion of Miss Lynda Grier, who spoke before the British Association for the Advancement of Science at Southampton. "But where ability is equal, it is true that any charm belonging to the work will lower the wages," she said, referring to the underpaid professional workers, common in England as well as in America.
